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AIR FILTER

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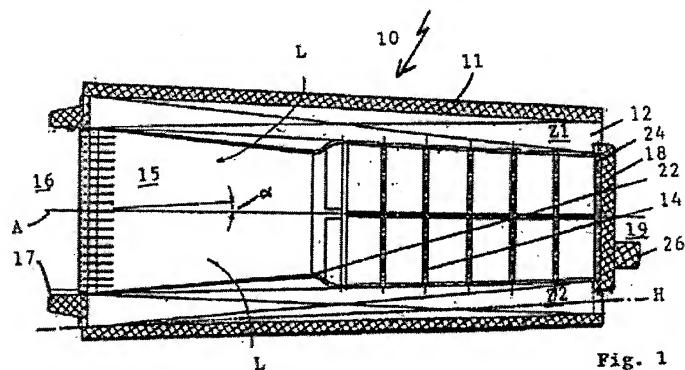
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The subject matter of the present invention relates to an air filter, in particular for cleaning the air that has been drawn in by a combustion engine. In the mounted position of the filter, the longitudinal axis (A) of the cartridge (10) which is conically tapered towards its front end (19) is slanted at such an angle (α) relative to the horizontal line (H) that water that has penetrated the air filter, rather than entering the combustion chamber of the engine, can drain toward the front end (19) of the cartridge through the sloping water discharge channels formed by the ribs (13), that project upward and downward, of the paper filter element (12).



Background of the invention

[0001]

The subject matter of the present invention relates to an air filter which can be used primarily for cleaning the air that has been drawn in by a combustion engine, which filter comprises an elongated air-permeable outer jacket, a paper filter element with radial ribs that are folded in the longitudinal direction -- which filter element rests close to the inside wall of the outer jacket -- and an elongated supporting element which supports the inside of the paper filter element which defines an inside chamber through which air passes and which has a discharge opening that closely adjoins the combustion engine, with the outer jacket and the paper filter element forming a closed circumferential contour, with the drawn-in air flowing through the outer jacket and through the paper filter element into the inside chamber and from there through the discharge opening to the combustion engine, and with the cartridge that is formed at least by the paper filter element and the supporting element having a conical shape, thus ensuring that it has a larger cross section in the area of the discharge opening and is tapered in the direction of the oppositely lying front end.

Closest prior art

[0002]

This type of air filter is known, for example, from the German Patent No. DE 29 48 781 A1 (corresponding to WO 79/00978).

[0003]

Filters of many different designs are used to clean the air that has been drawn in by a combustion engine. In most cases, such air filters have a replaceable paper filter element which is folded in the longitudinal direction and which retains the dust and other pollutants entrained with the air. Because of the limited space in the engine chamber of an automotive vehicle, such an air filter frequently has an elongated conical shape, as does the air filter of the above-mentioned German Patent No. DE 29 48 781 A1 (corresponding to WO 97/00978) which corresponds to the precharacterizing part of Claim 1.

[0004]

When such an air filter with an elongated conical shape is mounted in a horizontal position, such as is mainly the case in passenger vehicles, there is a risk that the water particles that have entered the air filter along with the drawn-in air are drawn into the combustion chamber of the engine. For example, if the vehicle is driving on a road that is wet from rain, the splash water, and, after snow fall, snow dust can enter the air filter. This snow dust melts as a

result of the higher temperature prevailing in the engine chamber, and the snow melt water seeps through the paper filter element. The conical shape of the air filter may even further promote the passage of the entrained water into the combustion chamber of the engine.

Abridged version of the invention

[0005]

Thus, the problem to be solved by the present invention is to improve a generic, substantially horizontally mounted air filter in such a way that water that has entered the air filter can no longer reach the combustion chamber of the engine.

[0006]

According to an essential aspect of the invention, an air filter according to the present invention is characterized in that in the mounted position of the filter, the joint longitudinal axis of the cartridge comprising at least the paper filter element and the supporting element forms an angle relative to the horizontal line so that in the area of the air discharge opening, this longitudinal axis is located at a higher level than in the area of the oppositely lying front end and that means for allowing water entrained with the drawn-in air to drain through drainage channels which slope downwardly toward the front end and which are defined by ribs of the paper filter element, which ribs, in the mounted position of the filter, project upwardly and downwardly.

[0007]

In this manner, water that has penetrated the air filter according to the present invention can drain in the drainage channels which slope downwardly toward the front end and which are formed by the upward and downward projecting ribs of the paper filter element and can no longer reach the combustion chamber of the engine.

[0008]

In a further development of the invention, at least the paper filter element and the supporting element present inside form an integral unit, i.e., the filter cartridge.

[0009]

To even further improve the ability of water to drain from the air filter according to the present invention and at the same time to reduce the width of the air filter while maintaining the air throughput capacity at the same level, the cross section of the filter cartridge mentioned across its entire length has an oval or elliptical shape so that this cross section conically tapers

only in the longer cross-sectional axis and that said axis, in the mounted position of the filter, has a substantially vertical orientation.

[0010]

In another preferred embodiment, only the radially inwardly lying areas of the faces of the paper filter element have sealing elements glued to them. An oval or elliptical sealing element consisting of PUR foam and foam-injected so as to be located on the front end of the air filter according to the present invention has the shape of a disk and seals off the inside chamber defined by the supporting element on the front end of the filter but leaves open an annular area between itself and the outer jacket into which the downwardly sloping draining channels mentioned above which form the means for draining the water and which are defined by the upwardly and downwardly projecting ribs of the paper filter element open out.

[0011]

At the opposite end thereto, an additional sealing element of PUR foam is foam-injected in such a way that it surrounds the oval or elliptical discharge opening like a ring.

[0012]

The sealing element mentioned last projects outwardly like an annular bead. The face of this annular bead can be located in a substantially vertical plane.

[0013]

As already mentioned, only the radially inwardly lying areas of the faces of the folded paper filter element are intimately connected, i.e., glued, to the above-mentioned sealing elements that are made of PUR foam.

[0014]

In an advantageous embodiment of the present invention, the supporting element that is located inside the paper filter element is injection-molded from a plastic material in one piece with the diffuser that projects toward the engine.

[0015]

This measure ensures that the hollow inside chamber of the air filter is optimally utilized and at the same time ensures an acoustic damping effect inside the air filter. By injection molding the supporting element from a plastic material in one piece with the diffuser, the manufacturing costs are reduced.

[0016]

To ensure optimum air permeability and, at the same time, protect the paper filter from being clogged by flying snow, the elongated air-permeable outer jacket is made of a nonwoven filter material which thus prevents a drastic reduction of the performance of the combustion engine caused by the flying snow clogging the paper filter element. In addition, the nonwoven filter material of the outer jacket also increases the service life of the air filter.

[0017]

The following description will elucidate additional characteristics and useful properties of the air filter according to the present invention in greater detail, especially if read with reference to the enclosed figures in the drawing. Specifically, as can be seen:

- Figure 1 shows a preferred embodiment of the air filter in the form of a diagrammatic longitudinal section in the vertical direction, which illustrates the conical shape and the slanted mounting position of the air filter according to the present invention;

- Figure 2 shows a longitudinal section through the same embodiment in the horizontal direction:

- Figure 3 shows a plane top view of the front end which in Figures 1 and 2 is located on the right side; and

- Figure 4 shows a plane top view of the face oriented toward the combustion engine, with the air discharge opening 16 of the preferred practical example of the air filter as shown in Figures 1-3.

[0018]

In Figure 1, an embodiment of an air filter according to the present invention has the shape of an elongated conical and oval or elliptical cartridge 10 which comprises a paper filter element 12 and a combined supporting and diffuser element 14,22 (see also Figures 3 and 4). The cartridge mentioned is surrounded by an equally conical and oval or elliptical elongated outer jacket 11 made of a nonwoven filter material, thus ensuring that air L can be drawn from the outside of the outer jacket 11 through the paper filter element 12 into the inside chamber 15 and that, at the same time, dirt particles, such as dust, that are entrained with the air are trapped in the paper filter element 12. The outer jacket 11 that is made of a nonwoven filter material keeps coarser particles, e.g., flying snow possibly entrained with the air, away from the paper filter element 12, thus ensuring that these particles cannot clog the paper filter element 12.

[0019]

In the direction toward the combustion engine, the filter cartridge 10 has an oval or elliptical air discharge opening 16 (see Figure 4) which is surrounded by a sealing element 17 having an oval or elliptical shape and being designed in the form of an annular bead. The sealing element is foam-injected using PUR foam, thus ensuring that it effectively seals the adjacent face of the paper filter element 12. The oppositely lying front end of the filter cartridge 10 is sealed off by means of a second oval or elliptical disk-shaped second [sic] sealing element 18 which is also made of PUR foam in such a manner that it seals off the inside chamber -- which is defined by the supporting element 14 -- on the front end 19 of the filter cartridge, but leaves open an annular region between itself and the outer jacket 11 into which the drainage channels described below of the paper filter element open out. In Figure 1, reference number 24 designates an annular adhesive area in which the second sealing element 18 is glued solely to the radially inwardly lying areas of the adjacent face of the paper filter element 12. To support the air filter on a component provided therefor, an outwardly projecting supporting lug 26 is disposed on the second sealing element 18.

[0020]

Figure 1 shows the air filter according to the present invention and the filter cartridge 10 in its mounted position, with the longitudinal axis A of cartridge 10 being slanted by a small angle α relative to the horizontal line H so that in the area of the air discharge opening 16, the longitudinal axis A mentioned of cartridge 10 is located at a higher level than in the area of its oppositely lying front end 19.

[0021]

The reason and purpose of the measure mentioned last will become more obvious when the function of the means for draining the water is described below on the basis of Figure 3.

[0022]

Figure 2 shows that cartridge 10 tapers only relative to the vertical dimension shown in Figure 1 in the direction of the front end 19 but not relative to the horizontal dimension shown in Figure 2. The exception is the diffuser 15 which is injection-molded from a plastic material in one piece with the supporting element 14 and which, as Figures 1 and 2 show, continuously widens toward the discharge opening 16.

[0023]

Below, the means Z1,Z2 for draining the water -- which, in combination with the previously described slanted position of cartridge 10 shown in Figure 1, allow water that has entered the filter to be discharged from the front end 19 -- are described on the basis of Figure 3 which shows a diagrammatic top view of the front end 19 of the embodiment of the air filter, which embodiment is shown in the form of longitudinal sections in Figures 1 and 2. In Figure 1, these drainage means are identified only by reference characters Z1 and Z2, but in Figure 3, they are obviously recognizable as zones Z1,Z2 which are surrounded by a broken elliptical line. In zones Z1 and Z2, the ribs 13 of the paper filter element 12 that is folded in the longitudinal direction project upwardly and downwardly and, in between, form water discharge channels 20 and 21 which, due to the slanted mounted position of cartridge 10, which can be seen in Figure 1, also slope downwardly toward the front end 19. Because of the conicity of cartridge 10, this slant of the discharge channels 20,21 is more pronounced in discharge zone Z1 than in discharge zone Z2. Since only the radially inwardly lying annular area 24 of the paper filter element 12 is glued to the sealing element 18 disposed there, the downwardly slanted water discharge channels 20 and 21 open up toward the above-mentioned annular opening on the front end 19. From that opening, the water that has entered can flow into a filter housing (not shown) and from there toward the outside and thus cannot enter the combustion chamber of the engine by way of the air discharge opening 16.

[0024]

And finally, Figure 4 shows a plane top view of the face, pointing toward the engine, of the air filter shown in Figures 1-3 with the air discharge opening 16 which is surrounded by an oval or elliptical annular bead of the first sealing element 17.

[0025]

To conform to a vertical area or flange of the combustion engine, the face of the surface facing the combustion engine, i.e., of the annular bead of the first sealing element 17, can be in a vertical position in spite of the slanted position of the cartridge. This is implemented by means of an appropriate slant of the annular bead of sealing element 17.

[0026]

Figure 3 and 4 also clearly show the vertical position of the long cross-sectional axis a.

[0027]

The materials used to manufacture the air filter according to the present invention described above on the basis of Figures 1-4 are lightweight and inexpensive; they include, in particular, a plastic material, paper, PUR foam and an adhesive. The entire filter cartridge 10 shown in Figures 1-4 constitutes an integral unit. This unit can be manufactured with or without the outer jacket 11 made of a nonwoven material, it can be shipped from and stored in the plant, and it can be distributed by the dealer.

[0028]

According to the present invention, the longitudinal axis of an elongated and conical air filter that is suitable primarily for cleaning the air drawn into a combustion engine is slanted relative to the horizontal line. This ensures that the intermediate spaces between the upwardly and downwardly projecting ribs of the conical paper filter element, which intermediately spaces form the water discharge channels, are also slanted relative to the horizontal line, thus ensuring that water that has penetrated the air filter can be discharged from the front end of the air filter, which front end is located opposite to the combustion engine. The inside chamber of the air filter is fitted with a diffuser which is injection-molded from a plastic material in one piece with the supporting frame, which diffuser effectively reduces noise. The outer jacket made of a nonwoven filter material is useful in that it protects the paper filter element from flying snow and thus ensures that a clogging of the air filter which can decrease the engine performance is prevented.

Claims

1. An air filter, in particular for cleaning the air that has been drawn in by a combustion engine, with
 - an elongated air-permeable outer jacket (11),
 - a paper filter element (12) having radial ribs (13) that are folded in the longitudinal direction and lying close to the inside wall of the outer jacket (11),
 - an elongated supporting element (14) supporting the inside of the paper filter element (12), with the supporting element defining an inside chamber (15) through which air passes and which has an air discharge opening (16) that closely adjoins the combustion engine, with the outer jacket (11) and the paper filter element (12) forming a closed circumferential contour, with the drawn-in air (L) flowing through the outer jacket (11) and through the paper filter element (12) into the inside chamber (15) and from there through the discharge opening (16) to the combustion engine, and with the cartridge (10) that is formed at least by the paper filter element (12) and the supporting element (14) having a conical shape, thus ensuring that it has a larger

cross section in the area of the discharge opening (16) and is tapered toward the oppositely lying front end (19), characterized in that

in the mounted position, the joint longitudinal axis (A) of the cartridge (10) forms an angle relative to the horizontal line (H) so that this longitudinal axis (A) in the area of the air discharge opening (16) is located at a higher level than in the area of the oppositely lying front end (19), and

that means (Z1,Z2) for draining water that has entered along with the drawn-in air are formed by defined discharge channels (20,21) that slant downwardly to the front end (19) between the ribs of the paper filter element (12), which ribs, in the mounted position of the filter, project upwardly and downwardly.

2. The air filter as in Claim 1, characterized in that at least the paper filter element (12) and the supporting element (14) are rigidly connected to each other.

3. The air filter as in Claim 1 or 2, characterized in that across its entire length, the cross section of the filter cartridge (10) mentioned has an oval or elliptical shape, that said cross section is conically tapered only relative to the longer cross-sectional axis (a) and that in the mounted position of the filter, this longer cross-sectional axis (a) is substantially vertically oriented.

4. The air filter as in any one of the preceding claims, characterized in that sealing elements (17,18) are disposed on the front ends, to which sealing elements the two front ends of the paper filter element (12) are glued only on their radially inwardly lying areas (24).

5. The air filter as in any one of the preceding claims, characterized in that the supporting element (14) forms a conical frame structure which is formed in one piece with a diffuser (22) that adjoins and ends at the air discharge opening (16).

6. The air filter as in Claim 5, characterized in that the supporting element (14) and the diffuser (22) are injection-molded in one piece from a plastic material.

7. The air filter as in any one of the preceding claims, characterized in that the outer jacket (11) is made of a nonwoven filter material.

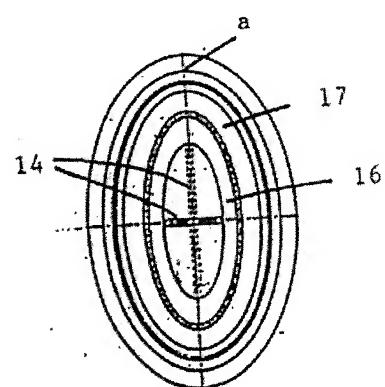
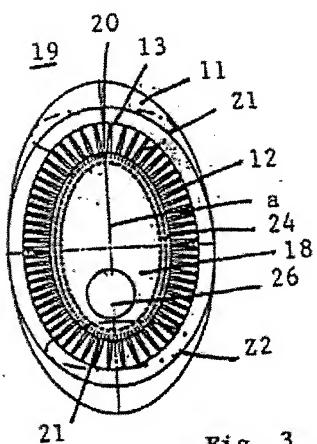
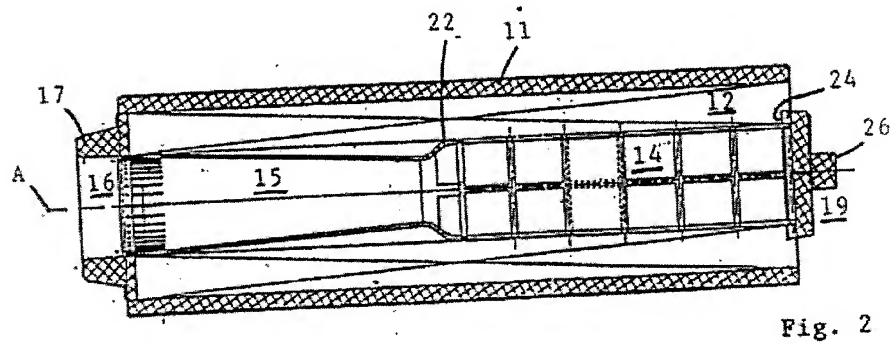
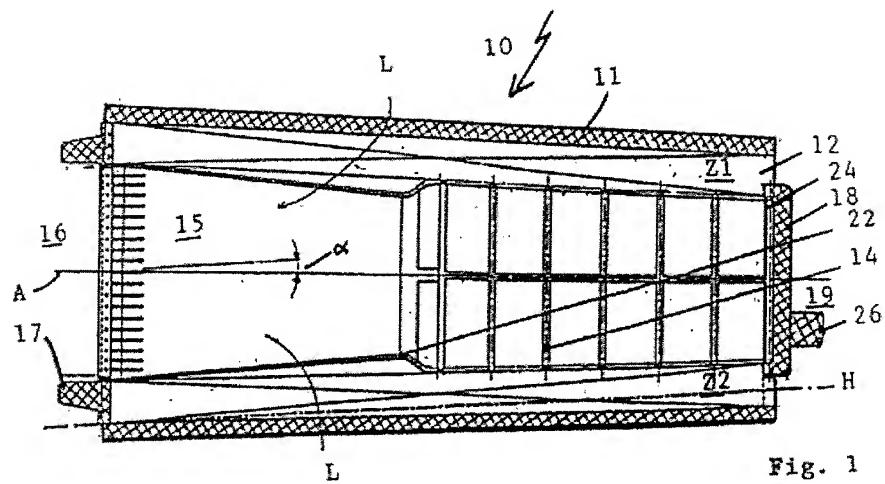
8. The air filter as in any one of Claims 4-7, characterized in that a first sealing element (17) made of PUR foam surrounds the oval or elliptical air discharge opening (16) like a ring and that it effectively seals off the adjacent face of the paper filter element (12) with one of its surfaces and with its other surface that faces toward the combustion engine projects like an annular bead.

9. The air filter as in Claim 8, characterized in that the face of the surface, facing toward the combustion engine, of the first sealing element (17) is substantially vertical.

10. The air filter as in any one of Claims 4-9, characterized in that a second oval or elliptical sealing element (18) which is made of PUR foam has the shape of a disk and

effectively seals off the inside chamber (15) on the front end, said inside chamber being defined by the supporting element (14), but leaves open an annular region between itself and the outer jacket (11) into which the discharge channels (20,21) of the paper filter element (12) open out.

11. The air filter as in Claim 10, characterized in that an axially outwardly projecting supporting lug (26) is formed in one piece with the second sealing element (18).



European
Patent Office

Application Number
EP 98 12 3275

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ⁶)
Category	Citation of document with indication where appropriate, of relevant passages	Relevant to claim	
D, Y	WO 79 00978 A (DONALDSON COMPANY) November 29, 1979 * page 5, line 12, to page 11, line 30; figures *	1-11	B01D46/24 F02M35/04
Y	GB 2 070 969 A (ENGINEERING COMPONENTS LTD) September 16, 1981 * page 2, line 27 to line 120; Figures 1,2 *	1-11	
The present search report has been drawn up for all claims.			TECHNICAL FIELDS SEARCHED (Int. Cl. ⁶)
Place of search The Hague	Date of completion of the search March 22, 1999	Examiner Bogaerts, M.	B01D F02M
CATEGORY OF CITED DOCUMENTS			
X:	Particularly relevant if taken alone.	T:	Theory or principle underlying the invention.
Y:	Particularly relevant if combined with another document of the same category.	E:	Earlier patent document, but published on, or after the filing date.
A:	Technological background.	D:	Document cited in the application.
O:	Non-written disclosure.	L:	Document cited for other reasons.
P:	Intermediate document.	&:	Member of the same patent family, corresponding document.

APPENDIX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN
PATENT APPLICATION NO.

EP 98 12 3275

In this appendix, the patent family members of patent documents listed in the above-referenced European Search Report are indicated.

The data on the family members correspond to the state of the files of the European Patent Office on March 22, 1999
These data serve only for information and are given without guarantee

Patent document listed in the search report		Date of publication	Member(s) of the patent family	Date of publication
WO 7900978	A	November 29, 1979	US 4211543 A BE 875825 A CA 1122544 A CH 646344 A FR 2432331 A GB 2036593 A, B JP 55500278 T NL 7903225 A SE 424266 B SU 1074389 A ZA 7901940 A	July 8, 1980 August 16, 1979 April 27, 1982 November 30, 1984 February 29, 1980 July 2, 1980 May 8, 1980 October 26, 1979 July 12, 1982 February 15, 1984 July 30, 1980
GB 2070969	A	September 16, 1981	AU 538226 B AU 6750381 A DE 3106614 A FR 2476499 A JP 1489502 C JP 56158120 A JP 63040126 B SE 450552 B SE 8101143 A ZA 8101041 A	August 2, 1984 September 3, 1981 January 14, 1982 August 28, 1981 March 23, 1989 December 5, 1981 August 9, 1988 July 6, 1987 August 24, 1981 March 31, 1982

For additional details regarding this Appendix: see Official Journal of the European Patent Office No. 12/82